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Land & Water

Conserving Natural Resources in Illinois

University of Illinois at Urbana-Champaign, College of Agriculture, Cooperative Extension Service

A Plan For The Land

Erosion-Control Alternatives

The First Step in Planning

Those who drive through the Illinois countryside might not notice it, but there has been a gradual change in the landscape.

Cleanly plowed fields, with deep furrows of black, rich earth (the result of after-harvest plowing), are not as frequent as they once were. In their place are fields that have been tilled less or not tilled at all; fields with varying amounts of crop residue on the soil surface.

Conventional tillage, especially moldboard plowing in the fall after harvest, has been a major cause of water erosion on sloping Illinois soils, and it has increased wind erosion on dark, level prairie soils. Much of this tillage once was necessary to control weeds, insects, and diseases; but today's better methods of pest control now offer alternatives to the moldboard plow.

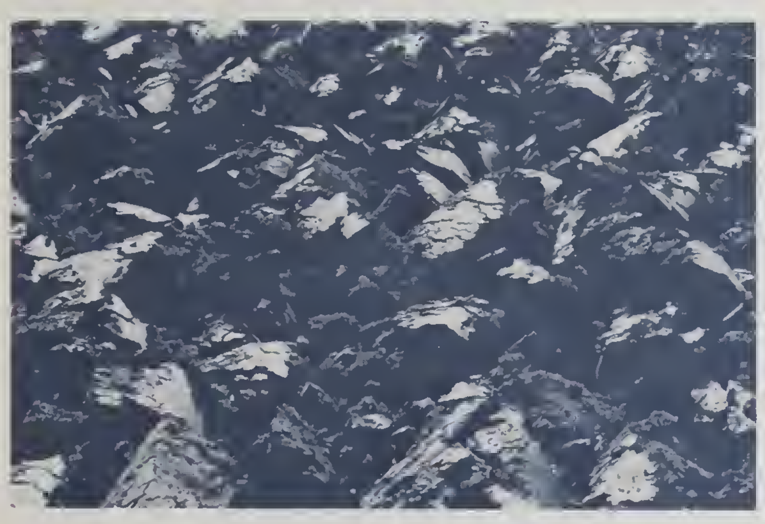
As a result, more and more farmers are opting for conservation tillage, a concept that combines minimal amounts of tillage and minimal uses of energy to leave residue on the ground and reduce soil erosion caused by wind and water.

Amid the increasing interest in conservation tillage, though, keep in mind that this is only one of many alternatives for controlling erosion. There is no single, pre-packaged, ready-made conservation plan that suits all fields, solves all problems, fits all situations, or meets all needs.

An effective erosion-control plan should match an individual farm and take into consideration a variety of factors: the severity and type of erosion, as well as tillage practices, wildlife considerations, drainage systems, fertility and herbicide programs, livestock feed needs, livestock wastes, crop rotations, energy uses, farm and field sizes, available capital, and soil types.

An erosion-control plan should be tailored to a field's dominant slope where the greatest potential for erosion exists. Assistance in developing a plan is available through the local soil and water conservation district office.

The first step is to figure out the severity of erosion on the farm using the Universal Soil Loss Equation. To learn how to use the equation, obtain a copy of "Estimating Your Soil Erosion Losses" from the local Cooperative Extension Service office.



Moldboard plowing, which leaves the soil surface exposed, is still common in Illinois . . .

. . . but it is giving ground to conservation tillage, an increasingly popular practice in which the soil is protected with a residue cover.

Once an erosion problem has been assessed, there is a variety of conservation practices and structures to choose from. All of them are designed to accomplish one or more of the following objectives:

1. Buffer the ground from the splash impact of raindrops by maintaining as much cover as possible on the soil surface.
2. Reduce the amount of runoff.
3. Reduce the velocity of runoff.
4. Manage soils so they can best resist erosion.

The following are some of the major conservation alternatives that put these objectives into practice:

Terraces

Terraces are earth embankments, channels, or combinations of embankments and channels constructed across field slopes. Essentially, they reduce erosion by shortening the length of the slope. The shorter the slope, the less chance there is for runoff to build enough momentum to cause excessive erosion.

Terraces also channel runoff safely away through outlets—either tile drains or grassed waterways. Because they control the flow of water over long slopes, they prevent the formation of gullies and often allow more intensive use of row crops on sloping land that otherwise would erode excessively.

Three modern types of terraces are typically used in Illinois. The first is the broad-base terrace, in which all slopes are designated to be farmed. On steep land, however, constructing farmable back slopes means the movement of a large amount of earth, more danger of machinery overturns, and considerably more expense.

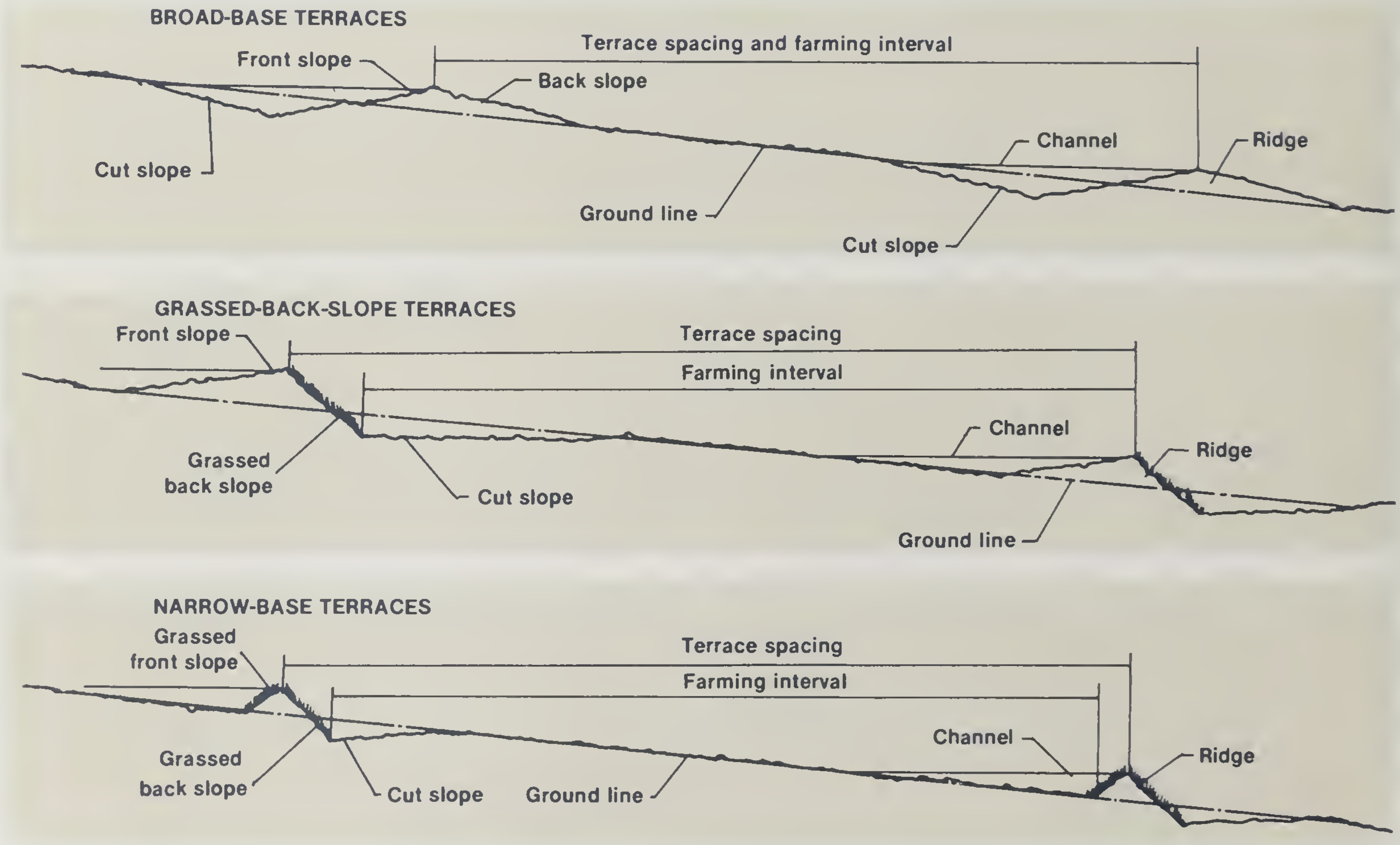
In such cases, a grassed-back-slope terrace often is used. With this type, the back slope is graded to a steep pitch and grassed. Less earth needs to be moved.

The third type, the narrow-base terrace, further reduces the amount of earth that must be moved to construct the terrace. The ridge is narrow and grassed on both sides. Because it is narrow, only a small area of the field is removed from production. This type of terrace is typically the least expensive to build and is best adapted to steep slopes.

No-till and Reduced Tillage

The most talked-about erosion-control practice is the one that already has been touched on lightly—conservation tillage. Conservation tillage is a broad term used to describe any tillage system that reduces soil erosion. The two most common variations are reduced tillage, in which some crop residue is left on the ground; and no-tillage, in which almost all of the residue is left on the soil surface.

Crop residue, which protects the soil from rainfall and reduces the velocity of runoff, is the key to



These cross-sections show three types of terraces found in Illinois—the broad-base terrace, the grassed-back-slope terrace and the narrow-base terrace.

erosion control with these practices. Residue is measured as a percentage of surface cover. For example, "40 percent surface cover" means that residue covers 40 percent of the ground. And with this percentage of cover, the amount of erosion is roughly half of that on land with no residue cover.

However, there are differences between corn and soybean residue. It is harder to leave as much soybean residue as corn residue on the ground because it is more easily buried and there is not nearly as much of it to begin with. Also, after soybeans are grown, the soil is generally believed to be looser and, consequently, more erodible. As a result, erosion is greater on ground following soybeans than it is following corn.

No-till is the most effective tillage system in terms of leaving residue on the ground and saving soil. (See Table 1.) With no-till, a farmer can expect erosion reductions up to 70 to 95 percent, depending on the amount of residue left by the previous crops.

When no-till is used on poorly drained, dark-colored soils, yields tend to be slightly lower than with conventional tillage. However, on land where the greatest erosion problems exist and no-till is most needed—well-drained, rolling land—yields usually are comparable to conventional tillage. In dry years, no-till yields may even be higher.

Reduced tillage serves as a compromise between no-till and moldboard plowing. Some tillage is done, but it is kept to a minimum with reduced-tillage implements—the chisel plow and the disk harrow.

A chisel plow with straight points operating in corn stalks leaves an estimated 60 to 70 percent of the surface covered with residue, while a moldboard plow leaves residue cover ranging from only 0 to 5 percent.

As for disks, two types are used in Illinois—tandem and offset disks. The tandem disk, which is the most popular of the two, leaves enough corn residue to cover about 70 percent of the ground while an offset disk (with 24-inch blades or larger, 6 inches deep) leaves just 25 to 50 percent of the surface covered.

Conservation tillage systems call for more reliance on herbicides for weed control than conventional tillage; but basically, they require the same good management practices as any successful tillage system—close monitoring and controlling of weeds, insects, and crop diseases.

Conservation tillage systems, particularly no-till, sometimes require specially designed equipment. For example, the planter may need to be equipped with coulters, extra weight, and other attachments to cut the residue, to place the seed at the desired depth and in good contact with the soil, and to properly cover the seed. Also, fertilizer programs may need adjustment because less tillage means less incorporation of fertilizers. But such management adjustments are not insurmountable problems; and in return, the savings in soil are substantial.

Table 1. Corn residue reduction from tillage operations*

Tillage Operation	Percent of Corn Residue Remaining After Tillage
No-till planting	90 - 100
Chisel plow, straight shanks	60 - 70
Chisel plow, twisted shanks	40 - 50
Field cultivator (with sweeps)	75 - 80
Tandem disk after harvest before other tillage	85 - 90
Tandem disk after previous tillage	40 - 60
Offset disk (24-inch blades, 6 inches deep)	25 - 50
Moldboard plow	0 - 5
Overwinter decomposition	70 - 75

*Soybean residue usually provides less surface cover on the soil than corn residue after tillage.

Ridge-Planting

Ridge-planting, which is another form of conservation tillage, has been gaining interest in Illinois. The major advantage of ridge-planting is that it both reduces erosion and adapts well to poorly drained soils.

With this practice, ridges are created during the previous growing season. During cultivation, soil is thrown toward the rows to form ridges; and then the next spring, corn residue is chopped while soybean residue is left undisturbed. Planting is done directly on top of the ridges.

Ridge-planting calls for a no-till planter with a coulter and a sweep or a set of disks in front to cut off the tops of ridges and push residue between rows. Because the ridges provide drainage and are not covered with residue, the soil dries quickly. That's why ridge-planting can work well on poorly drained soil.

Other advantages include the following:

- Because residue is pushed into the furrows between ridges, there is little or no residue to interfere with the planter.
- Even without tillage, the ridge tops usually are ideal seedbeds.
- Wind erosion is almost completely eliminated.
- Ridges allow early planting, sometimes even earlier than if fall plowing was done.
- Although ridge-planting calls for some specialized equipment, less machinery is required. The only necessary implements are a planter, cultivator, and stalk chopper.

The major disadvantage is that ridge-planting is not as flexible as flat-land planting. Farmers *must* cultivate to control weeds and form ridges for the next season. Also, when ridges are formed, lower soybean pods can be covered.

Crop Rotations

Including grasses and legumes in the crop rotation can reduce soil losses significantly. For example, with good fertility management, the average annual soil losses from a five-year rotation of small grain, meadow and three years of corn is about half that of continuous cropping to corn.

Once again, the key to erosion-control success with this strategy is soil cover. Grasses and legumes give much better protection to the soil than row crops. And even when a meadow is plowed under, it leaves the soil with improved infiltration and in a less erodible condition through the next year and sometimes for two years to come.

Although the evidence is strong that a sod-based rotation reduces erosion and a good legume crop is a valuable source of nitrogen, economics have favored continuous row crops. Generally, the best way to market forage crops is for livestock feed.

Contour Farming

Contour farming is the practice of doing all tillage and planting across the slope. Because contour channels run across the slope, they prevent runoff from flowing directly downhill and gaining the velocity to cause erosion.

This practice is most effective on slopes of 2 to 7 percent where it can cut in half the erosion that occurs with uphill and downhill farming. It often is used with terraces; and contrary to popular belief, contouring can be made to work with large equipment.

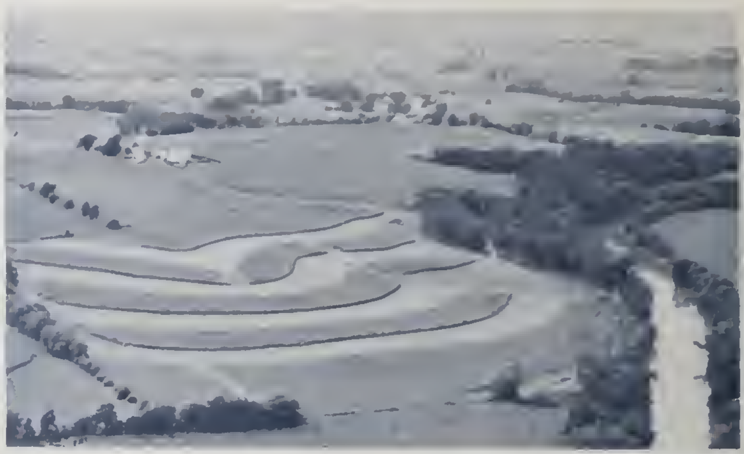
Contouring also can be taken a step further with contour strip-cropping. This is when strips of sod are alternated with strips of row crops or small grain, all planted on the contour.

Improved Soil Fertility Management

Improving soil fertility not only boosts yields; it can help reduce soil erosion. An improved soil-fertility program will help the crop canopy to develop faster; and a crop canopy protects the soil from raindrop splash. In addition, an improved soil-fertility program can result in crops that leave more residue on the ground following harvest.

Timing of Field Operations

After fall tillage, the soil is exposed to the erosive forces of thaw and snowmelt runoff and early spring rain runoff. So, another way to minimize erosion is to delay tillage from fall to spring.



Contour strip cropping on sloping areas alternates strips of row crops with strips of sod.

Grassed Waterways

The grassed waterway best fits under the category of water management rather than soil management. However, these two categories overlap because proper management of water usually means less erosion.

Grassed waterways are natural or constructed watercourses and outlets that are shaped or graded, then planted with suitable vegetation. They carry away runoff, preventing water from following a haphazard, gully-slicing course across a field.

Grassed waterways serve as outlets for terraces, diversions, or other concentrations of water; but they don't take the place of erosion-control measures on adjoining slopes. Silt in a grassed waterway is evidence that the adjacent hillsides are eroding excessively.

Land Use Change

An estimated 9½ million of state's 24 million acres of cropland suffer from excessive erosion. On nearly 900,000 of these acres, the erosion problem cannot be solved unless the land is shifted from row crop production to permanent cover, such as grass or timber. The land is simply too erosive for intensive farming, even when various conservation practices are put to use. As with the crop rotation strategy, though, the economics of this alternative can be an obstacle.

Three Goals

The conservation possibilities go on. For instance, other options are seasonal cover crops, grade stabilization structures, or vegetative field borders. Furthermore, an effective erosion-control plan usually combines several of these practices so the options multiply.

The major goals of any plan should be to preserve the soil indefinitely while maintaining maximum food production for human use and providing adequate economic returns for the producer.

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Table 2. Average annual erosion in tons per acre on different slopes and soil types*

2 percent slope, 300 feet long

	Central-Northern Illinois (Soils: Flanagan, Muscatine, Herrick, Ipava)	Southern Illinois (Soils: Hoyleton, Cisne)
C-Sb, conventional tillage, fall plowing	6	9
C-Sb, contour farming	3.5	5
C-Sb, chisel plowing (20-40% soil cover)	3.5	5
C-Sb, chisel plowing, contour farming	2	3

4 percent slope, 250 feet long

	Central-Northern Illinois (Soils: Catlin, Tama)	Southern Illinois (Soils: Hoyleton, Alford)
C-Sb, conventional tillage, fall plowing	14	18
C-Sb, chisel plowing	8	10
C-Sb, contour farming	7	9
C-Sb, chisel plowing, contour farming	4	5
C-Sb, no-till	4	5
C-Sb, no-till, contour farming	2	3

8 percent slope, 200 feet long

	Northern-Central Illinois (Soils: Catlin, Tama)	Southern Illinois (Soil: Ava)
C-Sb, conventional tillage, spring plowing	27	38
C-Sb-W-M-M, conventional tillage, spring plowing	9	12
C-Sb, no-till	8	13
C-Sb-W-M-M, no-till	3	4

12 percent slope, 200 feet long

	Northern-Central Illinois (Soils: Fayette, Seaton)	Southern Illinois (Soils: Alford, Sylvan)
C-Sb-W-M-M-, conventional tillage, spring plowing	17	17
C-Sb-W-M-M, conventional tillage, spring plowing, contour farming	12	12
C-Sb-W-M-M, no-till	5	5.6
C-Sb-W-M-M, no-till, contour farming	4	4

*C = corn, Sb = soybeans, W = wheat, M = meadow. The soils used in these examples are typical for their areas of the state. They have soil loss tolerance levels that generally range from 4 to 5 tons per acre annually.

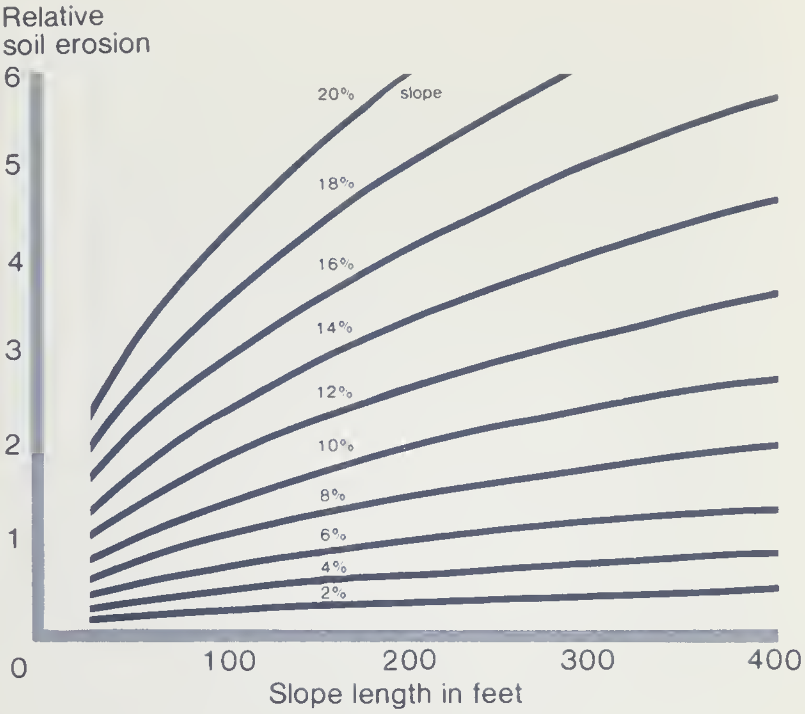

Figure 1. This graph shows how soil erosion becomes more severe as slopes get longer and steeper.

To maintain the soil indefinitely, erosion must be brought within the soil-loss tolerance level, also known as the T value. When erosion *exceeds* the T value, soil is being lost so fast that its natural productivity is being diminished. Generally, the T value for most Illinois soils is 1 to 5 tons of soil loss per acre per year.

In the process of preserving soil with the various conservation practices, there will be additional benefits. For example, leaving crop residue, establishing waterways, and maintaining vegetative field borders also protect wildlife and improve water quality.

With all of this in mind, let's explore the typical erosion-control systems for different slopes. (See Table 2 and Figure 1.)

0 To 2 Percent Slopes

Zero to 2 percent slopes, which are described as "nearly level," normally do not have severe sheet or rill erosion problems, even when they are intensively farmed. Drainage needs on these slopes usually are a greater concern to the landowner.

Because erosion is not a major concern, conventional tillage with the moldboard plow still is widely used and usually is an acceptable system following a crop like corn on 0 to 2 percent slopes. Typically, moldboard plowing is done in the fall so the workload is more evenly distributed over the year.

However, even though the moldboard plow usually does not cause severe water erosion on level land, it does expose the soil to wind erosion—an annoying and highly visible problem to the general public. Wind erosion generally is greatest on dark, level prairie soils or on sandy soils.

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Substituting the chisel plow for the moldboard plow and avoiding fall tillage of soybean land are two ways to control wind erosion on most soils. But field windbreaks, cover crops, and check strips may be necessary on the more erosion-prone soils—sandy soils, for instance.

As slopes reach 2 percent, water erosion can begin to exceed acceptable levels on the longer slopes. One solution is to use a chisel plow on corn land and leave soybean land untilled.

In southern Illinois, the potential for an erosion problem is even greater than in northern or central Illinois. In southern Illinois, rainfall intensities are higher and the soil is more erodible. Controlling erosion on 2 percent slopes in southern Illinois may call for a combination of conservation tillage and contour farming, or a crop rotation on some of the longer slopes.

2 To 5 Percent Slopes

Land with 2 to 5 percent slopes is defined as "gently sloping" and is typically cropped intensively. Erosion can easily get out of hand on these slopes, especially when a corn-soybean rotation is used.

Let's look at an example on a 4 percent slope 250 feet in length. The soils in the example are typical for central and northern Illinois and have a tolerance level of 4 to 5 tons per acre per year. Using the Universal Soil Loss Equation, we find that conventional tillage with fall plowing results in an average annual erosion rate of 14 tons per acre; chisel plowing, 8 tons; and contour farming, 7 tons.

Some of the options to bring erosion within the tolerance level include: a combination of chisel plowing and contouring; no-till; or no-till on the contour. On long slopes, the additional treatment of terraces may be needed for an intensive crop rotation—assuming that terraces fit the field.

On typical southern Illinois soils with the same slope, conventional tillage results in 18 tons of soil loss per acre per year; but no-till corn and soybeans may bring erosion within the tolerance level.

One way conventional tillage still may be used without excessive erosion is if a farmer has sod crops in the rotation.

5 To 10 Percent Slopes

Five to 10 percent slopes, defined as "sloping land," also are often cropped intensively. But when slopes reach this steepness, sod crops in the rotation are necessary in most cases to meet the tolerance level.

Take as an example an 8-percent slope 200 feet in length. On typical central or northern Illinois soils, conventional tillage with spring plowing results in a whopping 27 tons of soil loss per acre annually. And a rotation of corn-soybean-wheat-meadow-meadow only reduces erosion to 9 tons. One way to get soil loss within the tolerance level is to use the same rotation and plant the corn and soybeans no-till.

By applying this example to southern Illinois soils, the erosion figures are higher, but the solution still is the same—a corn-soybean-wheat-meadow-meadow rotation with the corn and soybeans planted no-till.

Terraces, contouring, and contour strip-cropping are effective on 5 to 10 percent slopes; however, terraces become especially costly to build on the steeper slopes.

10 Percent and Greater Slopes

As slopes get even steeper, erosion-control alternatives become more limited. For instance, when slopes exceed 10 percent, there probably is no way to economically control erosion without including a grass-legume rotation—even if no-till is used.

Also, contouring is not as effective on steep slopes because contour channels have less capacity to hold water. In fact, when slopes reach 18 to 24 percent, contouring is almost totally ineffective. The best uses for slopes over 18 percent are pasture, woodland, or wildlife habitat.

The Juggling Act

These are just some examples of the juggling acts landowners may have to do to solve the erosion problem on a specific piece of land. The SCS office will provide assistance in developing several optional plans for a producer to choose from.

Before any of these options can be put into use, however, several other critical ingredients first must be present. There needs to be an awareness of the problem plaguing the soil; there needs to be a conservation ethic; and there needs to be a desire to keep the land from slowly slipping away, soil particle after soil particle after soil particle.

And the reward for all of this? A landowner should have an assurance that his or her land will remain productive and that the great terrain robbery will be halted.

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